

AMENDMENTS TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

1. (Currently Amended) A test chart color measuring system comprising:

a color image taking apparatus which takes up a color image of a test chart in which specified color samples are respectively arrayed in sections divided in a matrix manner to output image signals of a plurality of color components; and

an image processor which extracts image signals corresponding to color samples based on the density of the taken test chart image, and calculates a color value of each color sample using the extracted image signal, wherein

the color image taking apparatus has an optical system including a telecentric optical system that includes:

a field lens arranged such that an optical axis of the field lens coincides with a normal to an opening at which the test chart is placed, and
a focusing lens arranged at the focal point of the field lens.

2. (Previously Presented) The test chart color measuring system according to claim 1, wherein the color image taking apparatus includes:

a main body having an opening at which the test chart is placed;

an illuminator which is accommodated in the main body and illuminates the test chart placed at the opening; and

a color image pickup device which has a plurality of spectral sensitivities different from each other, and picks up an image of the test chart to output image signals corresponding to the plurality of spectral sensitivities, wherein

the optical system introduces light beams having a specified direction from the test chart to the color image pickup device.

3. (Previously Presented) The test chart color measuring system according to claim 2, wherein:

the illuminator illuminates the test chart in a direction of 45° to a normal to the opening; and

the optical system introduces reflection light beams propagating along the normal to the opening from the test chart.

4. (Previously Presented) The test chart color measuring system according to claim 3, wherein the illuminator includes:

a light source arranged on the normal to the opening;

first and second planar reflectors arranged in symmetrical positions with respect to the normal passing through the light source for reflecting beams from the light source;

a first collimating lens arranged such that the focal point of the first collimating lens is located at the light source and adapted to collimate beams reflected by the first planar reflector into parallel beams to illuminate the test chart at the opening in the direction at $+45^\circ$ to the normal; and

a second collimating lens arranged such that the focal point of the second collimating lens is located at the light source and adapted to collimate beams reflected by the second planar reflector into parallel beams to illuminate the test chart at the opening in the direction at -45° to the normal.

5. (Previously Presented) The test chart color measuring system according to claim 3, wherein the illuminator includes:

a light source arranged on the normal to the opening;

first and second concave reflectors arranged in symmetrical positions with respect to the normal passing through the light source and adapted to reflect and focus beams from the light source into parallel beams;

wherein the first concave reflector is arranged such that reflected beams illuminate the test chart at the opening in the direction at $+45^\circ$ to the normal; and

the second concave reflector is arranged such that reflected beams illuminate the test chart at the opening in the direction at -45° to the normal.

Claims 6 & 7 (Cancelled)

8. (Previously Presented) The test chart color measuring system according to claim 3, wherein the illuminator includes:

a light source arranged on the normal to the opening;

a plurality of planar mirrors arranged around the normal passing through the light source such that respective reflecting surfaces of the plurality of planar mirrors are substantially parallel to the normal and face the normal, and adapted to reflect beams from the light source; and

a collimating lens arranged such that the focal point of the collimating lens is located at the light source and adapted to collimate beams reflected by the plurality of planar mirrors into parallel beams to illuminate the test chart at the opening in directions at 45° to the normal.

9. (Currently Amended) The test chart color measuring system according to claim 8, ~~wherein the optical system is constructed by:~~

~~the collimating lens; and~~

~~a focusing lens arranged at the focal point of the collimating lens;~~

wherein the collimating lens is arranged such that the optical axis of the collimating lens coincides with the normal to the opening.

10. (Previously Presented) The test chart color measuring system according to claim 2, wherein the color image taking apparatus includes a drive controller which causes the color image pickup device to pick up images during a plurality of exposure periods different from each other, and the image processor calculates color values using image signals corresponding to exposure periods suitable for respective spectral sensitivities out of image signals obtained during the respective exposure periods.

11. (Previously Presented) The test chart color measuring system according to claim 1, wherein the image processor includes a display device, a display controller which controls the

display device to display an index indicating a partial area of an image taken up by the color image taking apparatus together with the taken image, and calculates color values within the area indicated by the index.

12. (Currently Amended) A test chart color measuring system comprising:

a color image taking apparatus which takes up a color image of a test chart in which specified color samples are respectively arrayed in sections divided in a matrix manner to output image signals of a plurality of color components; and

an image processor which extracts image signals corresponding to color samples based on the taken test chart image and information on section division, and calculates a color value of each color sample using the extracted image signal, wherein

the color image taking apparatus has an optical system including a telecentric optical system that includes:

a field lens arranged such that an optical axis of the field lens coincides
with a normal to an opening at which the test chart is placed, and
a focusing lens arranged at the focal point of the field lens.

13. (Previously Presented) The test chart color measuring system according to claim 12, wherein the color image taking apparatus includes:

a main body having an opening at which the test chart is placed;

an illuminator which is accommodated in the main body and illuminates the test chart placed at the opening; and

a color image pickup device which has a plurality of spectral sensitivities different from each other, and picks up an image of the test chart to output image signals corresponding to the plurality of spectral sensitivities, ~~and~~ wherein

the optical system introduces light beams having a specified direction from the test chart to the color image pickup device.

14. (Previously Presented) The test chart color measuring system according to claim 13, wherein:

the illuminator illuminates the test chart in a direction of 45° to a normal to the opening; and

the optical system introduces reflection light beams propagating along the normal to the opening from the test chart.

15. (Previously Presented) The test chart color measuring system according to claim 14, wherein the illuminator includes:

a light source arranged on the normal to the opening;

first and second planar reflectors arranged in symmetrical positions with respect to the normal passing through the light source for reflecting beams from the light source;

a first collimating lens arranged such that the focal point of the first collimating lens is located at the light source and adapted to collimate beams reflected by the first planar reflector into parallel beams to illuminate the test chart at the opening in the direction at $+45^\circ$ to the normal; and

a second collimating lens arranged such that the focal point of the second collimating lens is located at the light source and adapted to collimate beams reflected by the second planar reflector into parallel beams to illuminate the test chart at the opening in the direction at -45° to the normal.

16. (Previously Presented) The test chart color measuring system according to claim 14, wherein the illuminator includes:

a light source arranged on the normal to the opening;

first and second concave reflectors arranged in symmetrical positions with respect to the normal passing through the light source and adapted to reflect and focus beams from the light source into parallel beams;

wherein the first concave reflector is arranged such that reflected beams illuminate the test chart at the opening in the direction at $+45^\circ$ to the normal; and
the second concave reflector is arranged such that reflected beams illuminate the test chart at the opening in the direction at -45° to the normal.

Claims 17 & 18 (Cancelled)

19. (Previously Presented) The test chart color measuring system according to claim 14, wherein the illuminator includes:

a light source arranged on the normal to the opening;

a plurality of planar mirrors arranged around the normal passing through the light source such that respective reflecting surfaces of the plurality of planar mirrors are substantially parallel to the normal and face the normal, and adapted to reflect beams from the light source; and

a collimating lens arranged such that the focal point of the collimating lens is located at the light source and adapted to collimate beams reflected by the plurality of planar mirrors into parallel beams to illuminate the test chart at the opening in directions at 45° to the normal.

20. (Currently Amended) The test chart color measuring system according to claim 19, ~~wherein the optical system is constructed by:~~

~~the collimating lens; and~~

~~a focusing lens arranged at the focal point of the collimating lens;~~

wherein the collimating lens is arranged such that the optical axis of the collimating lens coincides with the normal to the opening.

21. (Previously Presented) The test chart color measuring system according to claim 13, wherein the color image taking apparatus includes a drive controller which causes the color image pickup device to pick up images during a plurality of exposure periods different from each other, and the image processor calculates color values using image signals corresponding to exposure periods suitable for respective spectral sensitivities out of image signals obtained during the respective exposure periods.

22. (Previously Presented) The test chart color measuring system according to claim 12, wherein the image processor includes a display device, a display controller which controls the

display device to display an index indicating a partial area of an image taken up by the color image taking apparatus together with the taken image, and calculates color values within the area indicated by the index.

23. (Currently Amended) A test chart color measuring system comprising:

a color image taking apparatus which takes up a color image of a test chart in which specified color samples are respectively arrayed in sections divided in a matrix manner and a marker indicating a boundary of sections are provided to output image signals of a plurality of color components; and

an image processor which extracts image signals corresponding to color samples based on markers in the taken test chart image, and calculates a color value of each color sample using the extracted image signal, wherein

the color image taking apparatus has an optical system including a telecentric optical system that includes:

a field lens arranged such that an optical axis of the field lens coincides with a normal to an opening at which the test chart is placed, and
a focusing lens arranged at the focal point of the field lens.

24. (Previously Presented) The test chart color measuring system according to claim 23, wherein the color image taking apparatus includes:

a main body having an opening at which the test chart is placed;

an illuminator which is accommodated in the main body and illuminates the test chart placed at the opening; and

a color image pickup device which has a plurality of spectral sensitivities different from each other, and picks up an image of the test chart to output image signals corresponding to the plurality of spectral sensitivities, wherein

the optical system introduces light beams having a specified direction from the test chart to the color image pickup device.

25. (Previously Presented) The test chart color measuring system according to claim 24, wherein:

the illuminator illuminates the test chart in a direction of 45° to a normal to the opening; and

the optical system introduces reflection light beams propagating along the normal to the opening from the test chart.

26. (Previously Presented) The test chart color measuring system according to claim 25, wherein the illuminator includes:

a light source arranged on the normal to the opening;

first and second planar reflectors arranged in symmetrical positions with respect to the normal passing through the light source for reflecting beams from the light source;

a first collimating lens arranged such that the focal point of the first collimating lens is located at the light source and adapted to collimate beams reflected by the first planar reflector into parallel beams to illuminate the test chart at the opening in the direction at $+45^\circ$ to the normal; and

a second collimating lens arranged such that the focal point of the second collimating lens is located at the light source and adapted to collimate beams reflected by the second planar reflector into parallel beams to illuminate the test chart at the opening in the direction at -45° to the normal.

27. (Previously Presented) The test chart color measuring system according to claim 25, wherein the illuminator includes:

a light source arranged on the normal to the opening;

first and second concave reflectors arranged in symmetrical positions with respect to the normal passing through the light source and adapted to reflect and focus beams from the light source into parallel beams;

wherein the first concave reflector is arranged such that reflected beams illuminate the test chart at the opening in the direction at $+45^\circ$ to the normal; and

the second concave reflector is arranged such that reflected beams illuminate the test chart at the opening in the direction at -45° to the normal.

Claims 28 & 29 (Cancelled)

30. (Previously Presented) The test chart color measuring system according to claim 25, wherein the illuminator includes:

a light source arranged on the normal to the opening;

a plurality of planar mirrors arranged around the normal passing through the light source such that respective reflecting surfaces of the plurality of planar mirrors are substantially parallel to the normal and face the normal, and adapted to reflect beams from the light source; and

a collimating lens arranged such that the focal point of the collimating lens is located at the light source and adapted to collimate beams reflected by the plurality of planar mirrors into parallel beams to illuminate the test chart at the opening in directions at 45° to the normal.

31. (Currently Amended) The test chart color measuring system according to claim 30, ~~wherein the optical system is constructed by:~~

~~the collimating lens; and~~

~~a focusing lens arranged at the focal point of the collimating lens;~~

wherein the collimating lens is arranged such that the optical axis of the collimating lens coincides with the normal to the opening.

32. (Previously Presented) The test chart color measuring system according to claim 24, wherein the color image taking apparatus includes a drive controller which causes the color image pickup device to pick up images during a plurality of exposure periods different from each other, and the image processor calculates color values using image signals corresponding to exposure periods suitable for respective spectral sensitivities out of image signals obtained during the respective exposure periods.

33. (Previously Presented) The test chart color measuring system according to claim 23, wherein the image processor includes a display device, a display controller which controls the

display device to display an index indicating a partial area of an image taken up by the color image taking apparatus together with the taken image, and calculates color values within the area indicated by the index.

34. (Currently Amended) A system for correcting a color output apparatus, comprising:

a test chart output controller which controls a color output apparatus to output a test chart for correction in which specified color samples are respectively arrayed in sections divided in a matrix manner;

a color image taking apparatus which simultaneously takes up a plurality of color images of the test chart to output image signals of a plurality of color components;

an image processor which extracts image signals corresponding to color samples based on the density of the taken test chart image, and calculates a color value of each color sample using the extracted image signal; and

a correction data calculator which calculates correction data for the color output apparatus based on respective color values of the color samples, wherein

the color image taking apparatus has an optical system including a telecentric optical system that includes:

a field lens arranged such that an optical axis of the field lens coincides
with a normal to an opening at which the test chart is placed, and
a focusing lens arranged at the focal point of the field lens.

35. (Currently Amended) A system for correcting a color output apparatus, comprising:

a test chart output controller which controls a color output apparatus to output a test chart for correction in which specified color samples are respectively arrayed in sections divided in a matrix manner;

a color image taking apparatus which takes up a color image of the test chart to output image signals of a plurality of color components;

an image processor which extracts image signals corresponding to color samples based on the taken test chart image and information on section division, and calculates a color value of each color sample using the extracted image signal; and

a correction data calculator which calculates correction data for the color output apparatus based on respective color values of the color samples, wherein

the color image taking apparatus has an optical system including a telecentric optical system that includes:

a field lens arranged such that an optical axis of the field lens coincides with a normal to an opening at which the test chart is placed, and
a focusing lens arranged at the focal point of the field lens.

36. (Currently Amended) A system for correcting a color output apparatus, comprising:

a test chart output controller which controls a color output apparatus to output a test chart for correction in which specified color samples are respectively arrayed in sections divided in a matrix manner;

a color image taking apparatus which takes up a color image of the test chart to output image signals of a plurality of color components;

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an image processor which extracts image signals corresponding to color samples based on markers in the taken test chart image, and calculates a color value of each color sample using the extracted image signal; and

a correction data calculator which calculates correction data for the color output apparatus based on respective color values of the color samples, wherein

the color image taking apparatus has an optical system including a telecentric optical system that includes:

a field lens arranged such that an optical axis of the field lens coincides with a normal to an opening at which the test chart is placed, and
a focusing lens arranged at the focal point of the field lens.